

Abstract of the Disclosure

A methods and apparatus for labeling an item using diffraction grating-based encoded optical identification elements 8 includes an optical substrate 10 having at least one diffraction grating 12 disposed therein. The grating 12 has one or more colocated pitches Λ which represent a unique identification digital code that is detected when illuminated by incident light 24. The incident light 24 may be directed transversely from the side of the substrate 10 (or from an end) with a narrow band (single wavelength) or multiple wavelength source, and the code is represented by a spatial distribution of light or a wavelength spectrum, respectively, or a combination thereof. The element 8 can provide a large number of unique codes, e.g., greater than 67 million codes, and can withstand harsh environments. The encoded element 8 may be used to label any desired item, such as large or small objects, products, solids, powders, liquids, gases, plants, minerals, cells and/or animals, or any combination of or portion of one or more thereof. The label may be used for many different purposes, such as for sorting, tracking, identification, verification, authentication, anti-theft/anti-counterfeit, security/anti-terrorism, or for other purposes. In a manufacturing environment, the elements 8 may be used to track inventory for production information or sales of goods/products.